USDA Forest Service
U.S. DEPARTMENT OF AGRICULTURE

Rocky Mountain Research Station

Science You Can Use *(in 5 minutes)*

NOVEMBER 2021

Do you know where your rangeland carbon is? New approach for estimating rangeland carbon stocks helps managers plan climate change mitigation strategies

A big sagebrush ecosystem that has converted to invasive annual grass in north central Nevada. Grasslands store carbon higher up in the soil profile where it is subject to atmospheric release from disturbance. Photo by Nolan E. Preece.

Globally, more carbon is stored in soil than any other terrestrial form. Rangelands, which cover more than half of the Earth's land surface, are important for storing carbon. Unlike in forests, most of the carbon pool in rangelands is found underground in the form soil organic carbon (SOC), which comes from decaying organisms. Scientists estimate that SOC makes up as much as 95 percent of carbon stored in rangelands.

"This is important because even modest changes in rangeland carbon sequestration can influence the global carbon cycle and thus climate," says Matt Reeves, Rocky Mountain Research Station research ecologist.

Methods for estimating how much carbon is stored in rangelands have been lacking—until now. Using existing models and soil data sets, Reeves and a team of RMRS scientists and managers in the Intermountain Region developed a way to quickly assess rangeland carbon. And the good news is the process can be applied at local or larger scales.

The technique involves assessing above ground carbon stocks in shrubs and below ground in SOC, which varies by plant community type. Carbon found in herbaceous species like grasses are not evaluated since that pool is so ephemeral and variable year to year. Compared to grasslands, shrublands store carbon deeper in the soil profile making it more likely to stay put. However, where sagebrush shrublands have shifted to nonnative annual grasses like cheatgrass, relatively more carbon occurs in the upper part of the soil horizon where it is subject to atmospheric release from disturbance. Scientists estimate that in the last 15 years, nearly 9 million tons of carbon have been lost in the Great Basin to this sort of conversion.

Rangeland carbon storage is likely to decrease under the warmer, drier conditions that are trending now and expected in the future. However, vegetation

management offers a concrete way to enhance SOC, especially on degraded sites where erosion outpaces soil replenishment.

Throughout Region 4, managers and planners like Jeff Bruggink, regional soils and BAER program manager in Ogden, Utah, are already using the new carbon estimation technique.

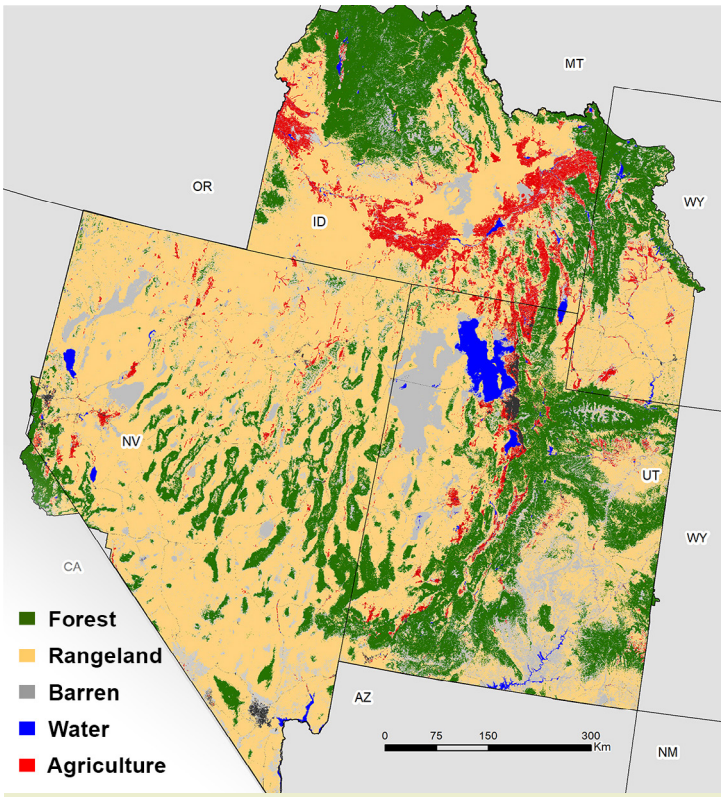
"The approach provides valuable information to make proper decisions today to ensure sustainability and productive ecosystems of the future," Bruggink says. "We're using it not only to develop a baseline to measure change, but also to determine where we might be able to increase carbon sequestration."

Standing carbon can be calculated either from plot level inventories or from spatial data describing shrub cover, height and species. The outputs help managers like Bruggink decide which types of management are most suited to maintaining or increasing carbon levels above and below ground and can be used to estimate where and how quickly ecosystems may change with a changing climate. The data are also useful for forest planning.

To access carbon data (SOC and above ground) for Region 4, contact Matt Reeves at matt.c.reeves@usda.gov.

Key Findings/Management Implications

- RMRS scientists have developed an approach to estimating carbon stocks in rangelands.
- Above- and belowground carbon storage in rangelands can be enhanced through vegetation management that includes deep-rooted perennial herbaceous plants, drought-tolerant herbaceous plants, and diverse native plants.
- Soil organic matter can be increased by increasing plant ground cover to protect soil and promote the formation of organic matter.
- Carbon stocks can be retained by limiting soil disturbance during management operations, limiting carbon losses due to catastrophic fires, and preventing conversion to invasive nonnative annual grasses such as cheatgrass.



Map showing areas of rangeland (tan color) in the Intermountain Region. Scientists estimate that soil organic carbon, which comes from decaying organisms, makes up as much as 95 percent of the carbon stored in rangelands. Map by Matt Reeves.

FURTHER READING

Reeves, Matthew C.; Hanberry, Brice; Bruggink, Jeffrey L.; Krebs, Michael A.; Campbell, Steven B.; Baggett, L. Scott. 2020. A novel approach for estimating nonforest carbon stocks in support of forest plan revision. Res. Note RMRS-RN-86. Fort Collins, CO: U.S. Department of Agriculture, Rocky Mountain Research Station. 20 p.

LEAD SCIENTIST

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